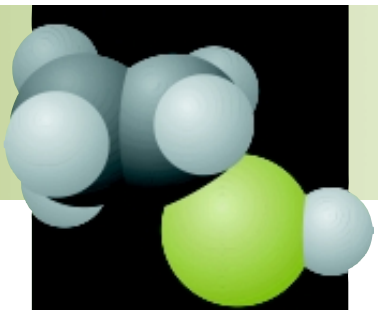
CHEMICALS

Project Fact Sheet



METAL DUSTING PHENOMENON

BENEFITS

- 475 billion Btu per day could be saved with 30 to 50 percent recovered
- Fewer maintenance shutdowns
- Increased productivity
- Reduction of $50 thousand per plant per year in operating costs
- Savings of $220-290 million annually in the hydrogen industry

APPLICATIONS

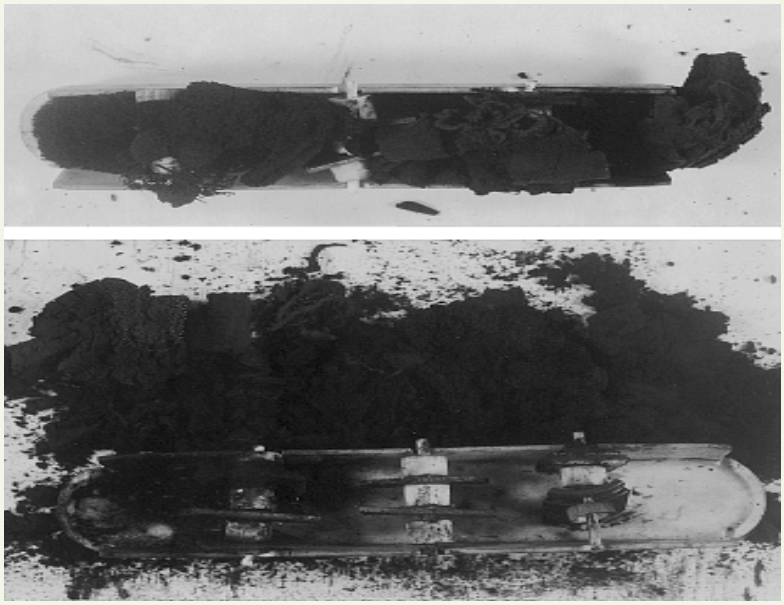
Initial applications of the information and materials developed are in hydrogen and synthesis gas production. Other chemical processes such as methanol production, and hydrocarbon and ammonia synthesis could also benefit from this technology. Processes in the forest products and petroleum industries could also use these new materials.

MATERIALS TO RESIST METAL DUSTING AND EXTEND EQUIPMENT LIFETIME

Metal dusting is a corrosion phenomenon which leads to the disintegration of structural alloys turning them into dust composed of fine particles of the alloy and carbon. Metal dusting occurs at temperatures of 800-1300°F with high carbon activity in the gas phase. These conditions are prevalent in many chemical and petrochemical processes. Currently the only way to protect materials against metal dusting is the addition of sulfur-containing compounds, but this often deactivates catalysts needed in the process. This project will examine the metal dusting phenomenon and work to develop materials resistant to metal dusting.

This effort will involve laboratory testing of materials in simulated process environments and field testing of materials in actual process environments. Novel surface engineering techniques will be used to modify the alloys. Altering the chemistry and structure of the surface will minimize the reaction between the surface and the carbonaceous materials in the gas phase. The collected data will be used in the development of a database on metal dusting, corrosion, and mechanical properties of materials.

EFFECTS OF METAL DUSTING



Macroscopic photographs of several alloy specimens after exposure at 1100°F for 100 hours in a laboratory simulated metal dusting environment with carbon deposit (top) and after carbon removal (bottom) .

Project Description

Goal: To study the metal dusting phenomenon in laboratory simulated process environments and in actual process environments, and develop a user-friendly knowledge base on materials/corrosion information for application in the chemical and petrochemical industries.

Progress and Milestones

Project research will focus on the following tasks:

- Characterize chemical process environments using computer modeling of gas phase reactions
- Perform corrosion testing of off-the-shelf candidate alloys in simulated metal dusting environments
- Develop surface-engineered materials based on results of corrosion tests
- Evaluate the role of system pressure in the initiation of corrosion/metal dusting of materials
- Perform corrosion tests on surface-engineered materials in simulated chemical environments over a wide temperature and pressure range
- Expose candidate alloys and surface engineered materials in several locations in pilot and/or production systems that produce hydrogen, methanol, syngas, and ammonia
- Select the best candidates from monolithic alloys and surface engineered materials and fabricate tube sections for exposure in pilot and/or production units for evaluation
- Develop database on metal dusting, corrosion, and mechanical properties of materials

Commercialization

The materials developed under this project will have broad applications in the chemical and petrochemical industry. A gradual implementation of new/modified materials is envisioned in U.S. plants for hydrogen production, ammonia and refinery reformers over the time period of 2005-2025.

Project Partners

Argonne National Laboratory
Argonne, IL

Materials Technology Institute
St. Louis, MO

Air Products and Chemicals, Inc.
Allentown, PA

Krupp VDM Technologies
Houston, TX

Allied Signal, Inc.
Hopewell, NJ

Allegheny Ludlum
Pittsburgh, PA

Avesta Sheffield
Schaumburg, IL

DuPont Central Research
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Duraloy Technologies, Inc.
Scottsdale, PA

Exxon Chemical Company
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February 2001